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Environmental Pre-Operational Survey Nine Mile Point

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ENVIRONMENTAL PRE-OPERATIONAL SURVEY

NINE MILE POINT NUCLEAR STATION

NIAGARA MOHAWK POWER CORPORATION

December, 1969

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Environmental Pre-Operational Survey - Nine Mile Point

I. Introduction

This report summarizes the preoperational environmental surveys conducted in the vicinity of the Nine Mile Point Nuclear Station No. 1 by Niagara Mohawk Power Corporation.

Survey results and other pertinent data are presented for both the land and lake (underwater) programs as described in the Final Safety Analysis Report (Volume II, Appendix D).

II. Pre-Operational Survey-Land Program

A. Program Development

Eleven environmental stations were set up in 1968 in accordance with the plans specified in the Nine Mile Point Nuclear Station Final Safety Analysis Report - Appendix D, page D-26. The locations of the five on-site and six off-site monitoring stations are illustrated in Figures 1 and 2, respectively. All stations are equipped with an air sampling pump, a rain and snow fallout collector, and a dosimeter (film badge) for integrated dose readings, in addition, each of the on-site stations and the Sector C off-site station include a recording gamma radiation monitor. Figure 3 is a photograph of a typical on-site station and its associated equipment. These stations were operated intermittently for approximately 18 months. The following objectives were realized during this period:

1. The locations selected were found to be accessible in all weather conditions.
2. No radiation anomalies were observed at any of the locations, so none of the stations had to be moved.
3. The equipment was operated under varying weather conditions and operated as designed with the following exceptions:
    a. The elapsed time meters on two of the air samplers were damaged by the vibration of the pump. All the elapsed time meters were moved from a mounting on the pump to a mounting on the base plate. No additional problems have been encountered in over ten months of operation.
    b. The soft rubber hoses used to connect the air sample holders to the pumps developed cracks after one year of operation. These hoses were replaced with harder-wall hoses which performed satisfactorily.

c. The cellulose membrane filters used for collecting air samples proved to be too fragile and were frequently broken when changing samples on windy days. Glass fiber filters with a comparable efficiency were substituted and have eliminated the handling problem.

d. The precipitation collectors were collecting more precipitation than could be accounted for by the one square foot opening on the cabinet. It was realized that some of the water striking the top of the monitor box was draining into the precipitation device. Silicone rubber was used to build a dam around the precipitation collector openings and in the subsequent seven months of operation, these devices have operated satisfactorily.

e. Radiation levels were so low that the recorders on the gamma monitors were driving down scale. To prevent damage to the recorders, small Cs-137 "bugs" were installed in the detectors to make them indicate slightly upscale (between 0.01 and 0.02 mR/hr).

f. The door latches on the cabinets broke frequently and were replaced with sturdier latches.

4. Personnel were trained in servicing the equipment in the monitoring stations.

B. Program Operation and Results

During the months of August and September, 1969, the stations were operated continuously and the samples were analyzed. This program accomplished the following:

a) Reiterated that no radiation anomalies were observed at any of the stations.

b) Trained personnel in the routine analysis of the environmental samples.

Results of the analyses performed during the pre-operational period are summarized below.

1. Film Badges

Film badges (sealed with dessicant to prevent exposure to moisture) were installed on all eleven monitoring stations in January of 1968. These badges have been changed monthly and have all shown statistically insignificant (less than 10 mR) exposures for each monthly period.

2. Gamma Monitors

The continuously recording gamma monitors were operated. The charts show little variation from the expected "bugged" background levels. Several of the monitors did develop electronic problems during this period and indicated upscale readings. These malfunctioning monitors were repaired as soon as the condition was observed. With the exception of these obvious malfunctions, the monitors indicated the radiation levels shown in Table 1. (Radiation levels are in mR/hr)

Table I

Month		On-Site Sectors					Off-Site Sector*
		D-1	D-2	E	F	G	C
August	Max.	0.012	0.012	0.6	0.03	0.5	0.016
	Avg.	0.012	0.012	0.015	0.015	0.05	0.016
	"Bugged" Bkgd.	0.012	0.012	0.015	0.015	0.02	0.016
Sept.	Max.	0.015	0.03	0.025	0.02	0.04	0.016
	Avg.	0.012	0.012	0.015	0.016	0.03	0.016
	"Bugged" Bkgd.	0.012	0.012	0.015	0.015	0.02	0.016

3. Precipitation Samples

The monitoring stations are equipped with a precipitation collector which has a one-square foot opening. The interior of the station is heated to prevent the collected precipitation from freezing in winter. Precipitation is collected for a one-month period and then brought to the lab for analysis. The gross beta results for three months are presented in Table 2. (Activities are in units of 10^{-10}uCi/ft^2/month.)

Table 2

Month	On-Site Sectors					Off-Site Sectors					
	D-1	D-2	E	F	G	C	D-1	D-2	E	F	G
July	5.4	2.2	4.3	7.8	12.9	8.1	5.2	5.1	20.2	10.3	---
August	13.4	14.0	15.1	14.4	22.7	10.5	2.4	18.1	14.6	13.4	15.4
September	0.2	1.0	1.6	0.7	0.3	5.0	5.1	1.4	2.2	1.1	1.0

*The C Sector is the only Off-Site location equipped with a Gamma monitor.

Gamma spectrums were run on typical precipitation samples during this period. There were no discernible peaks.

4. Air Samples

Air samples were collected at a typical flow rate of 2 cfm and were changed on a weekly basis. The gross beta activity detected 24 hours after the samples were removed is shown in Table 3. (Activities are in units of 10^{-13}uCi/cc.)

Table 3

Week	On-Site Sectors					Off-Site Sectors					
	D-1	D-2	E	F	G	C	D-1	D-2	E	F	G
7/28-8/4	4.1	4.2	4.3	3.6	3.8	2.9	3.5	4.2	4.6	2.5	4.4
8/4 -8/11	4.3	5.2	4.5	4.1	4.1	3.5	4.7	4.2	4.8	2.7	4.0
8/11-8/18	3.1	3.1	3.4	2.9	2.6	2.3	3.4	---	3.3	1.7	3.1
8/18-8/25	3.6	4.1	3.8	3.9	4.1	3.0	4.6	4.6	5.4	3.8	4.1
8/25-9/2	3.1	3.4	3.3	3.0	3.3	3.2	4.2	4.4	4.3	3.0	3.7
9/2 -9/8	2.6	---	2.0	2.4	2.7	2.5	3.8	3.7	4.8	3.3	2.8
9/8 -9/15	2.8	3.0	3.0	2.3	3.1	2.5	3.3	3.7	3.5	3.0	2.9
9/15-9/22	2.3	---	2.9	2.5	2.8	2.5	2.9	3.2	3.9	3.4	2.5
9/22-9/29	1.3	---	1.5	1.4	1.4	1.6	2.1	2.0	1.9	1.5	1.4

For comparison, the samples taken in the 45 weeks of sampling prior to August of 1969 showed that in wet or winter weeks, the gross beta activity ranged from 0.4 to 1.0 X 10^{-13}uCi/cc, while in dryer weather, the activity ocurred over a range of 1.5 X 10^{-13} to 5.0 X 10^{-13}uCi/cc. For further comparison, the sector averages for this 45-week period are presented in Table 4. (Activities are in units of 10^{-13}uCi/cc.)

Table 4

On-Site Sectors					Off-Site Sectors					
D-1	D-2	E	F	G	C	D-1	D-2	E	F	G
1.28	1.81	1.62	1.70	1.62	1.54	1.83	1.77	1.91	1.50	1.84

It is interesting to note that the State of New York Department of Public Health detected average gross beta activities of 0.9 X 10^{-13} to 2.0 X 10^{-13}uCi/cc in different locations in New York State during the year of 1968.[1]

Gamma spectrums were run on typical air samples during the two-month period. These spectrums show no clearly discernible peaks except when the six off-site samples were analyzed as a group. This analysis showed trace quantities of members of the uranium decay series.

5. Milk Samples

During the two-month period, homogenized store milk was purchased and the technicians trained[2] in the analysis of milk for gross beta, strontium and iodine. Raw milk samples were not obtained during this two-month period, but were obtained through the State Department of Public Health in October and November. The samples were from four farms around the Nine Mile Point site. The results of these analyses are presented in Table 5. (Activities are in units of pCi/1.)

Table 5

Farm	October, 1970			November, 1970		
	Gross Beta (1)	Iodine	Strontium	Gross Beta (1)	Iodine	Strontium
#1	1.61 X 10	(2)	(2)	1.55 X 10	Not Detectable	30
#2	1.69 X 10	(2)	(2)	1.87 X 10	Not Detectable	25
#3	1.72 X 10	(2)	(2)	1.61 X 10	Not Detectable	6
#4	1.55 X 10	(2)	(2)	1.24 X 10	Not Detectable	15

1) Includes beta from naturally occurring K-40.
2) Samples lost when raw milk coagulated on ion exchange columns. Chemical form of ion exchange resins changed to overcome problem.

[1] From: "Environmental Radioactivity in New York State - 1968", dated 7-14-69

[2] Spiked test samples were used to refine the analytical procedures

The State Department of Public Health has been sampling milk from these same farms for approximately 2 years. Their average results for the year of 1968 are presented in Table 6.[3] (Activities are in units of pCi/l.)

Table 6

Farm	Iodine - 131	Strontium-90
#1	Not Detectable	13
#2	Not Detectable	14
#3	Not Detectable	16
#4	Not Detectable	12

III. Radioanalysis of Aquatic Samples - Lake Program

In June, 1969, a survey was conducted to observe fish population and observe underwater growth off the Nine Mile Point shoreline. Seven specimens of fish were collected in conjunction with the fish net "population" survey. The nets were set out near the eastern boundary of the site in a line perpendicular to the shore. The shallowest net was located at a depth of about ten feet, fifty feet out from shore while the deepest net was positioned 700 feet from shore at a depth of 30 feet. Most of the fish obtained were from the shallow net. The sample specimens were frozen and shipped to Eberline Instrumentation Corporation for radioanalysis. Results are presented in Table 7.

The June Lake bottom survey indicated the greatest abundance of algae (primarily cladophora) occurred at a depth of about ten feet. A composite sample was collected from twelve locations located about 1,000 feet apart along the ten-foot depth contour and parallel to the shoreline. This sample was evaluated by radio-analysis along with specimens of clams (mussels) and gammarus (fresh water shrimp) collected from similar locations. Sample results are also tabluated in Table 7. Due to insufficient sample weight and low radioactivity of the gammarus, this sample was analyzed for gross beta activity only.

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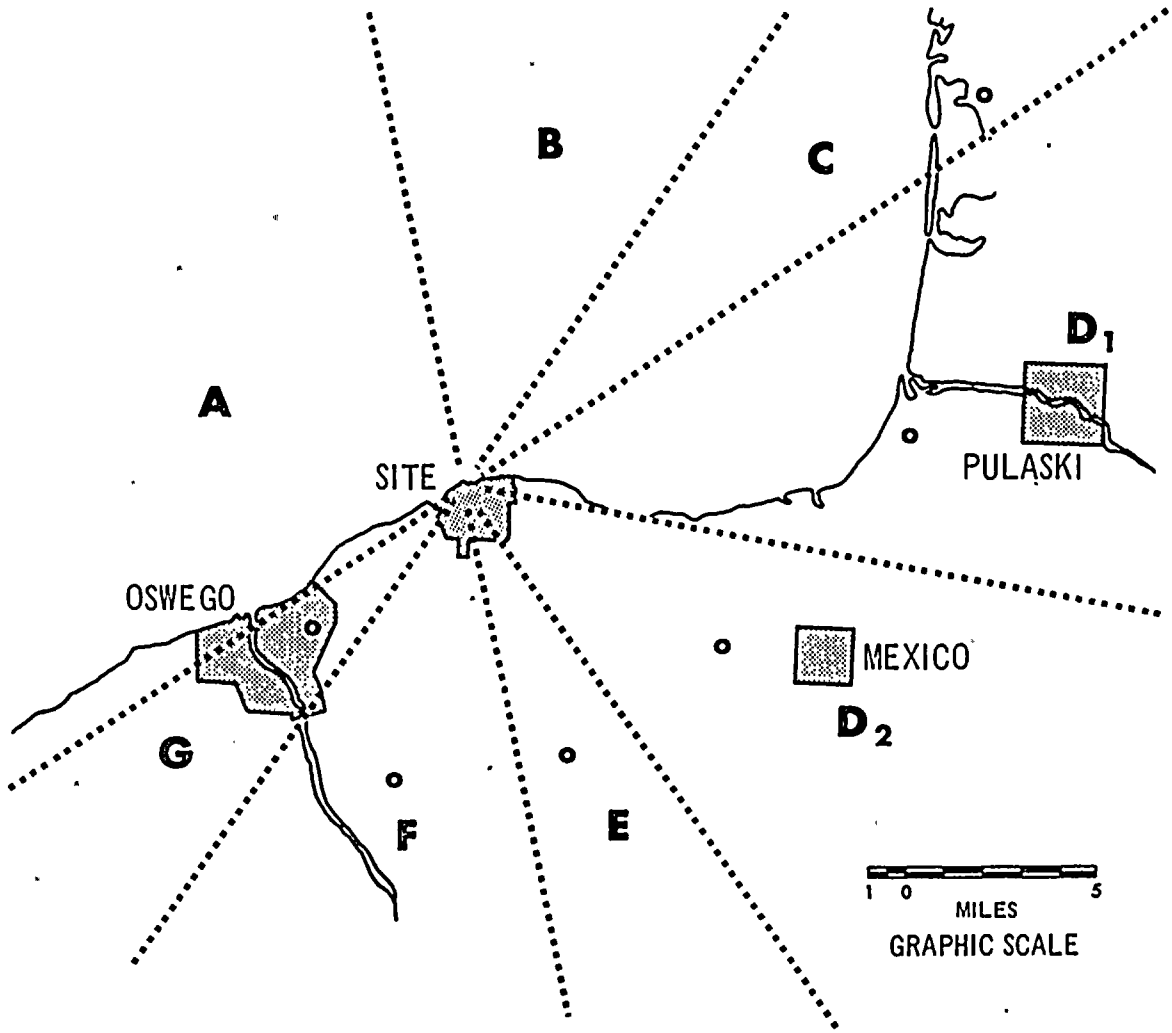
[3] From: "Environmental Radioactivity in New York State - 1968", dated 7-14-69

Table 7 Nine Mile Point Aquatic Samples - June, 1969
Results of Radioanalysis by Eberline Inst. Corp.

Species	Sample Weight (gms)		Picocuries (pCi) per sample (dry)					
	Wet	Dry	Gross Beta	Cs^{137}	Sr^{90}	Co^{60}	Zn^{65}	Gross Gamma
Northern Pike	2170	482	950±30	72±10	438±24	0.0±9.6	164±10	492±53
Northern Brown Bullhead	481	105	435±12	4.2±2.1	77±6	0.0±2.1	9.5±2.1	98±10
Small Mouth Bass	385	90	325±9	8±2	105±27	0.0±1.8	0.0±1.8	151±17
White Perch	273	66	135±6	36±1	46±3	3.9±1.3	2.0±1.3	125±14
Yellow Perch	200	49	144±5	7.8±1.0	102±5	0.0±1.0	1.5±0.9	100±11
Northern Redhorse Sucker	973	225	355±18	0.0±4.5	74±7	0.0±4.5	6.8±4.5	183±20
Pomolobus (Alewives)	39	8.5	34±2	1.6±0.1	17±4	0,0±0.2	2.0±0.9	22±2
Clams	689	363	55±18	58±7	167±15	18±7	105±7	167±18
*Algae	1820	61	13*	0.2±0.01*	2.41±0.12*	0.03±0.02*	0.07±0.02*	35.6±5.9*
Gammarus	0.083	---	0.53±0.22	---	---	---	---	---

*Note Algae results are in pCi/gm (dry) rather than pCi/sample.

OFF-SITE MONITORING STATION LOCATIONS



o MONITOR STATION

Figure 2

ON-SITE MONITORING STATION LOCATIONS

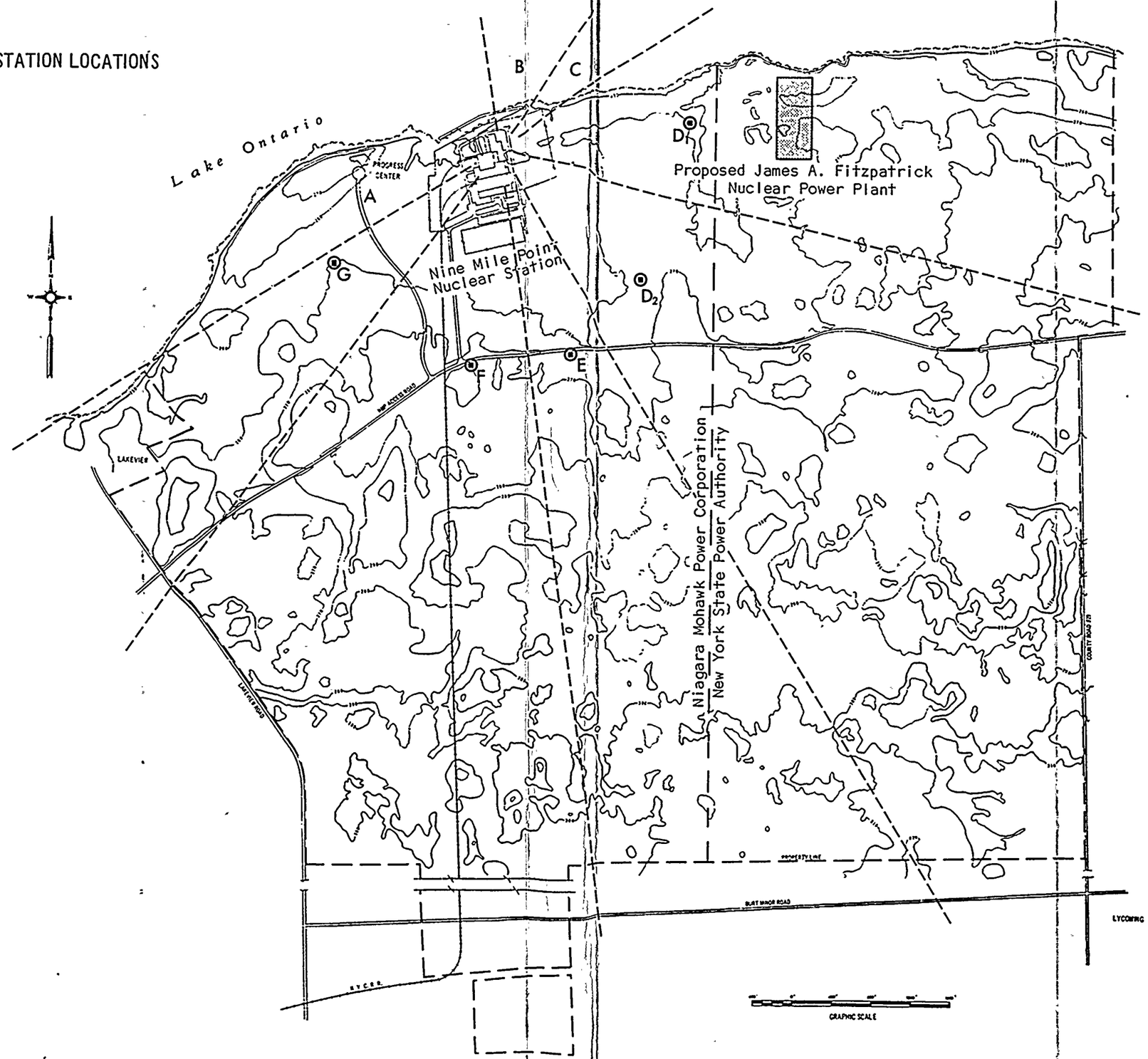
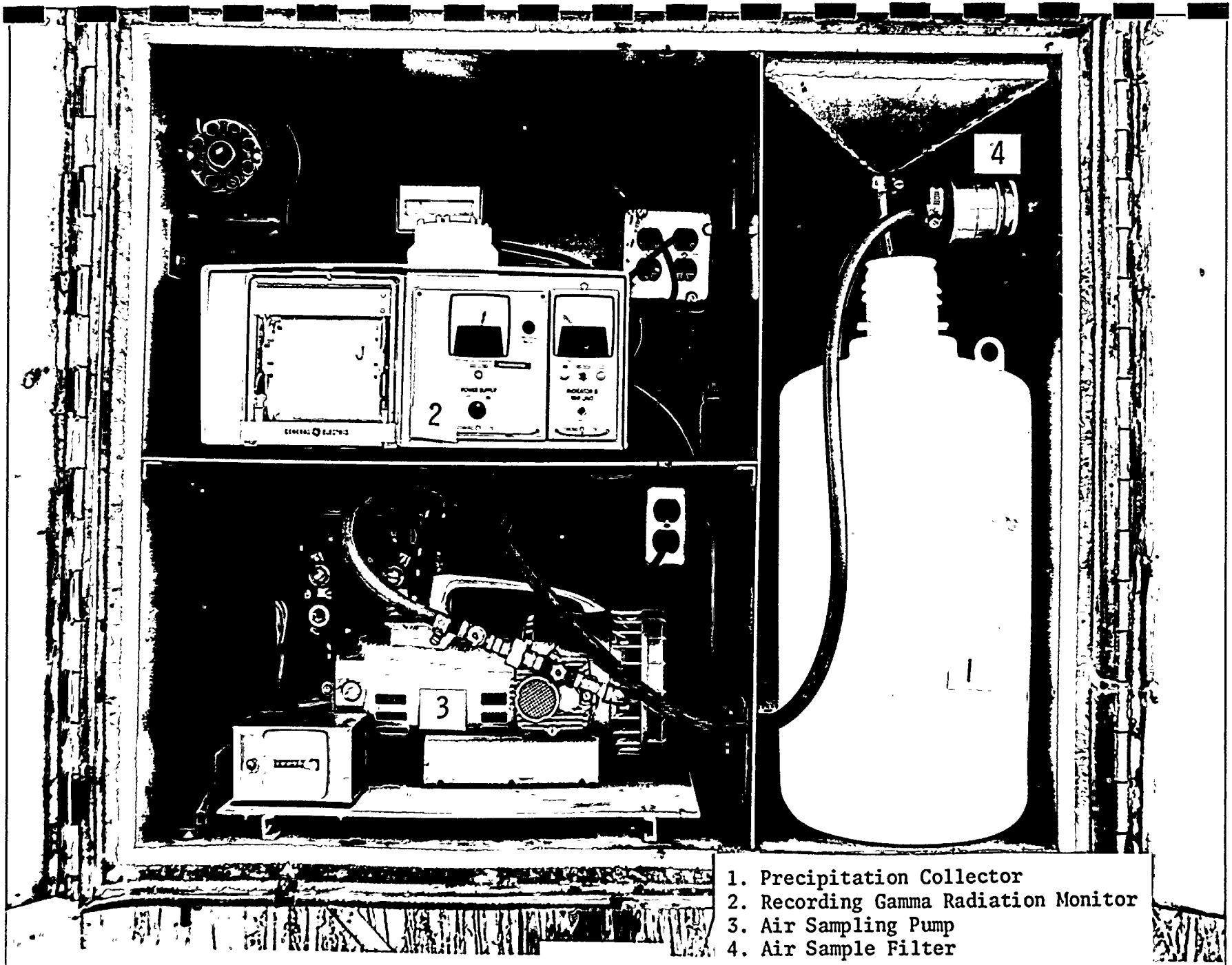


Figure 1



1. Precipitation Collector
2. Recording Gamma Radiation Monitor
3. Air Sampling Pump
4. Air Sample Filter

Figure 3

APPENDIX A

SUMMARY OF LAKE ONTARIO ECOLOGICAL STUDIES RELATIVE TO THE NINE MILE POINT NUCLEAR POWER STATION

Summary of ecological and ecologically related studies in Lake Ontario off the Nine Mile Point Nuclear Power Station

A. General

The first ecologically oriented studies were begun in the Spring of 1963. As with any ecologically oriented studies, the first efforts were directed toward establishing the physical background for ecological considerations. Gradually these studies ramified and eventually involved a primary study on the ecology of the benthic organisms which might be affected by the thermal discharge. The studies carried out in 1963 - 64 were concerned with the study of the currents in the lake and an estimate of the diffusion and dilution factor of the discharge plume itself. In all, almost 120 cruise days were spent in this two-year period on this and other aspects of the study. Because of the many aspects of this study, the various phases are treated separately below.

1. Diffusion Studies

Because of the close similarity in several aspects between the expected thermal discharge and the flow of the Oswego River, the effluent of the river was used as a diffusion model. The river carries a substantial chloride concentration which was easily measured by titration methods aboard the boat. The boat course plan could thus be modified as the day progressed and the direction and extent of the river's effluent traced out into the lake. It was also possible to determine the movement of the water along the shore of the Nine Mile Point promontory, the diffusion characteristics in that area, and other features such as upwelling. This basic method was supplemented by establishing a series of stations along the boat's course and collecting several water

samples at pre-determined depths for chloride analysis and temperature measurement. Capture drogue techniques were used to establish the direction and speed of the water current at the surface and at a 20-foot depth.

The most meaningful of these current patterns using both the chloride diffusion comparison and temperature profiles were presented in Appendix B, Limnology, Nine Mile Point, Nuclear Station Preliminary Hazards Summary Report, Volume II.

In general, these studies indicated high diffusion rates in the shallow areas of the lake and an almost constant current movement in the area.

2. Current Meter Studies

Supplemental to the above, two permanent current meters were anchored in 35 and 55 feet of water off the western end of the promontory to record current velocities at about the 25 and 45 foot depths over a period of several months. In both the above studies there was close correlation made to the wind patterns and the calms. Direction of current flow and duration of currents of various speeds were calculated.

The percentage of calms is estimated as being low, while the distribution of east and west currents is about equal. This current data was also used to calculate diffusion parameters.

3. Temperature Studies

In addition to taking the temperature of the water of each of the samples collected, bathythermograph records were made at a series of stations throughout the first two years of study. The primary use of these recordings was to record the gradual change in depth of the thermocline throughtout the season.

It was found that throughout the early summer, the isotherms slope downward toward the east with deep mixing taking place in August, lowering the surface temperature.

This study also supplied material to aid in calculating dilution.

4. Theoretical Study of Initial Dilution of the Effluent

The dilution factors resulting from turbulent mixing of the discharge of the effluent, the effect of the rising of the plume to the surface from a 15-foot depth and the effect of mixing due to currents resulting from density balance in the environment were calculated and/or otherwise studied.

It was calculated that 2X to 2.5X dilution would be achieved. Model studies later indicated dilution of about 3X due in part by the induced circulation by the entrainment of bottom water and the rise and spread of the warmer water.

The dilution calculations were reported in Appendix B, Limnology, Nine Mile Point Nuclear Station Final Safety Analysis Report, Volume II.

5. Dispersion Studies

During 1963 - 1964, about 1,200 drift cards were released in the area off Nine Mile Point. Of these, about 600 (more than half) were returned with the requested information.

The study indicated that the effluent from the station might be dispersed as far west as Rochester (62 miles) and as far northeast as Cape St. Vincent (28 miles). Presumably, some cards went down the St. Lawrence River.

Dispersion appears to be widespread which would result in large dilutions.

6. Plankton Studies

During 1964 plankton samples were collected over a 5-month period in the summer at three pre-determined points, two along the promontory and one out in the open lake.

It was concluded from the very erratic results in these samples that the area off the Nine Mile Point promontory is one of considerable change going from periods of some concentration of plankton with on-shore winds to periods of almost complete absence of the plankton in the area by off-shore winds or

upwellings, particularly in that area at the eastern end of the promontory. The information from the study was interesting from an academic point of view as to the seasonal distribution of the larger zooplankton but of very little applicable value.

7. Seiches, Tides, and Waves

These parameters were examined primarily on a historical and theoretical basis. Some seiches and internal wave effects were observed directly but appear to be of rather infrequent ocurrence although the internal waves may be of particular violence at times. In any case, they do not appear to play any major role related to the ecology except in modifying surface temperature condition in late summer.

Tides are almost non-existent.

Wave activity does play a major role in the ecology of the area. Almost all the area is heavily scoured and kept reasonably free of sand and silt. Wave activity may also reduce the Cladophora growth dramatically in a few days time by abrasion and breaking off of the longer strands.

8. Fathometric Studies

A program of evaluation of the aquatic population was begun in the summer of 1968. To evaluate the fish population, a series of transects using a recording fine line fathometer was made of the Nine Mile Point promontory at 100-foot intervals.

The transducer of the fathometer scans a 5^0 arc directly under the boat as the boat moves along. From this scan the number of fish per 1,000 $feet^2$ was calculated. Fish species were determined by netting.

In all, the area is sparcely inhabited by any fish useful commercially or for sports fishing. The only real concentration of fish was observed at a depth of 60 - 80 feet. Repeated attempts to identify these fish in deeper water failed. In any event, they would not be affected by the discharge.

9. Ecological Benthic Studies

Along the same transects indicated above, samples of bottom alga were collected over uniform areas (25 x 25 cm.) at a series of depths to 20 feet, the maximum depth of the attached algal growth. These samples were analyzed for members of each major biological species present.

The biological material appeared to be fairly sparce or at least less abundant than in other areas of the lake. The surveyed lake bottom area, less than 20 feet in depth, lies in a narrow band varying up to 500 feet wide along the shore. Greatest algal concentration appears at the 10-foot depth since in shallower water the longer algal strands tend to break off. The effluent may raise the temperature of the near-shore water by as much as 5° - 6°F in a shallow layer rapidly decreasing in temperature to the east or west as carried by the current. Such a rise would not appear to have much effect on the general benthic population since the bottom area affected would be quite limited. In any case, water temperatures above 65°F would probably depress the growth of the alga Cladophora somewhat dramatically. A study of the temperature relations of this alga is being carried out under the supervision of Dr. J. F. Storr, University of Buffalo Biology Department.

B. Summary

The studies were extensive and planned so as to explore a variety of physical and biological factors. The the total picture of the ecology of the area is one which is heavily wave swept, keeping the bottom generally free of rubble except at specific depths (near shore) and areas. For much of the area to the 20-foot depth there is exposed flat bedrock and little sand, particularly in the area close to the Nine Mile Point Nuclear station discharge. It is not known as an area for sports fishing, nor do there appear to be concentrations of any valuable species.

The near-shore area, close to the station, may be moderately influenced by the thermal discharge. This affect will diminish rapidly with distance and will

probably not be observed in the near-shore area beyond the limits of the promontory. This is due to the fact that the major currents observed flowed either parallel to, or lakeward in the area and these currents continued out into the open lake, at the east and west boundaries of the promontory.

In summary, the region is one of less than average benthic growth. The effect of the thermal input upon the biota is expected to be restricted to a relatively limited area. Benthic and fathometric studies are planned in the post-operational period to attempt to measure the actual effect of the thermal discharge.

APPENDIX B

ECOLOGICAL BENTHIC STUDY OFF NINE MILE POINT, LAKE ONTARIO

AUGUST, 1968

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Buffalo, New York 14226
Dec. 15, 1969.

Mr. R. Clancy,
Manager, Environment-Engineering,
Niagara Mohawk Power Corp.,
300 Erie Blvd., West,
Syracuse, N.Y. 13203.

RE: ECOLOGICAL BENTHIC STUDY OFF NINE MILE POINT, LAKE ONTARIO, AUGUST 12-16, 1968.

I. PURPOSE OF STUDY:

This was the initial benthic study made in the Nine Mile Point area to establish a biological background in the pre-operational periods. There had been a previous survey in the region of a very general nature consisting of a series of exploratory dives. This had established that the area was generally wave swept and the bottom, except in less than 10' of water almost entirely clear of rock rubble of any kind with very little benthic life present. This study was directed toward a quantitative evaluation of what was present.

II. PROCEDURE:

A. Field Work.

A series of transect lines were established from the shore out into the lake. Since the primary purpose of the transects was for purposes of comparison, they were to be of a permanent nature and along these transects all of the various ecological studies were to be carried out. In all nine transects were established with several not being used in the benthic study at this time. Those labelled with a prefix of W were to the west of the discharge; those with the prefix E, east of the discharge.

W-3 was located about 5,000' west of the discharge and about 3,000' from W-2. W-2 through W-3 were 1,000' apart with E-1 being just east of the actual discharge structure as no actual ecological work could be done in the immediate area of the structure which was under construction. E-6 uses the so-called eastern target as the shore base. This target was used in the early ecological lake studies (1963-64) as a location point for the boat work.

It is more than a mile east of the discharge.

W-3 is located in such a position that it is based on the SW - NE oriented shore that is the western side of the Nine Mile Point Promontory. It was found that currents flowing westward normally flow parallel to the almost W - E oriented northern shore of the promontory and thus these currents actually flow out into the open lake at the NW corner of the promontory. The W-3 transect was, therefore, established as a base line comparison transect for the study. E-6 is a mile east of the discharge and it was believed that this transect would be in an area in which the effect of the thermal effluent would not be great and this, then, was the eastern base-line transect. The studies in 1969 contemplated a much wider scope operation and the base-line transect was established in Mexico Bay a mile further east.

In working the transects for the benthic survey, a series of 3 samples was taken recovering all the biological material in a 25 X 25 cm. area with each sample. Four sampling stations were used along each transect at 5', 10', 15', and 20' The 20' depth marked the limit or near-limit of any attached plant growth, and was also felt to be beyond the depth of any likely temperature effect.

The sampling can be described as selective since the area close to shore in some locations is partially covered by various sized pieces of rock. This heterogeneous habitat could not be sampled accurately to yield a quantitative sample for comparative values. Sample areas, therefore, were restricted to flat rock for which the alga Cladophora has a preference. This alga is the only attached one present in large amounts although a sub species may occur in particular ecological niches, but was not found to occur in this particular area. The Cladophora is occupied by a number of organisms from various phyla and so the entire sample represents a very good cross-section of the benthic flora and fauna.

Variations in the concentration of the organisms present is due in large part to the physical structure of the bottom, the slope of the bottom, (which determines in part the wave effect) and the depth which regulates both the effect of the wave activity and the light intensity. Although the samples were taken from flat rock material, the roughness of the surrounding bottom also plays a major role in wave effect so that variations occur due to this roughness factor.

B. Laboratory Studies.

In the laboratory, the samples were individually separated into plant and animal material. The plant material was then thoroughly dried and weighed, then ashed, and the organic weight determined. As this program progressed, it was found that the alga Cladophora was such, that particles of silt were embedded or so closely surrounded by the hair-like material that a fraction of the inorganics could not be separated from the alga. Additional washing of the alga would have resulted in the removal of large amounts of algal material. The organic weight content is thus used for comparing algal concentrations although both dry weight and ash weight are also given in the table, (Table 2).

III. RESULTS AND DISCUSSION:

The data are presented in tables 1 and 2 and graphically illustrated in Figures 1-4.

By the August period the amount of algal material would be expected to decline, while the animal life would be on the increase. The alga, Cladophora, has its major growth during the maximum light period in June when both the light intensity and number of hours of illumination are at their greatest. Temperature at this time for most of the June period is between 55°F and 60°F. The optimum temperature for growth appears to be in the mid 60's with higher temperatures causing slowing of growth. Both light and temperature would play major roles on the lessening amount of growth found in August. In addition, observations have been made that the Cladophora goes through a series of cycles during the summer in which the strands of alga lengthen to a maximum then breaks off, a sort of self-mowing process. This would happen irregularly and at no fixed time, although there would tend to be periods which would suggest cyclic effect. Little, if any, algal growth occurred at the 20' depth and in these cases no sample was taken (marked N.S.T. on tables 1 & 2).

Benthic animals, on the other hand, are just into the period of active reproduction in June, lagging behind the plant growth as one would expect since this plant growth is the basic source of food. The various animals found in the Cladophora use the alga as both shelter and, in part, for food. This grazing may also be responsible for some decline in the total algal growth found.

Over the entire range of the transects the algal growth is fairly uniformly distributed with one exception

at the 15' depth at E-2 when more than double the amount of growth is present than at any other similar depth, and at W-3 where the algal growth is consistently less. It would now appear that the comparison transects, W-3 may not be as important as once thought. The ecology of W-3 is different than the remainder of the transects and will vary considerably due to particular wind directions. Only the area along the Nine Mile Point Promontory will have a consistent ecology throughout the season and it may well be that any effect on the ecology imposed by the thermal discharge will have to be a computed one based on the changes found at the various transects.

Since the entire study is one designed for comparison, there does not seem to be anything in particular that needs to be commented on or discussed at this time. Nor can any conclusions be based upon this one study which relates to the particular purpose of the study. The study, in itself, was revealing and the very consistent results (for a biological situation) were within acceptable limits and will provide comparative material. The results presented, are only the basic statistical results, while the original data will be essential in the overall analysis in the pre-operational period.

Table 1: Benthic Survey Data - Comparison of Transects
Oswego
August, 1968

	transect no.	organic wgt. (gms)	no. of snails (G. Lioplax)	no of. snails (G. Bethnia)	no. of snails (G. Physa)	no. of amphipods (G. Gammarus)	no. of insect larvae (G. Tendipes)	Miscellaneous
5'	W3	N.S.T.	-	-	-	-	-	-
	W1	4.21	0	0	0	125	12	1 fish larva
	E1	3.91	0	0	5	373	11	2 flatworms (G. Dugesia)
	E2	3.82	0	2	6	279	3	-
	E3	2.84	0	0	0	247	5	-
	E6	2.86	0	0	1	177	14	-
10'	W3	.31	0	0	0	19	0	2 flatworms (G. Dugesia)
	W1	2.51	0	1	0	146	1	1 flatworm (G. Dugesia)
	E1	2.50	0	0	1	172	13	-
	E2	2.68	0	0	0	186	2	-
	E3	1.81	0	0	0	159	3	-
	E6	2.40	0	0	0	195	8	-

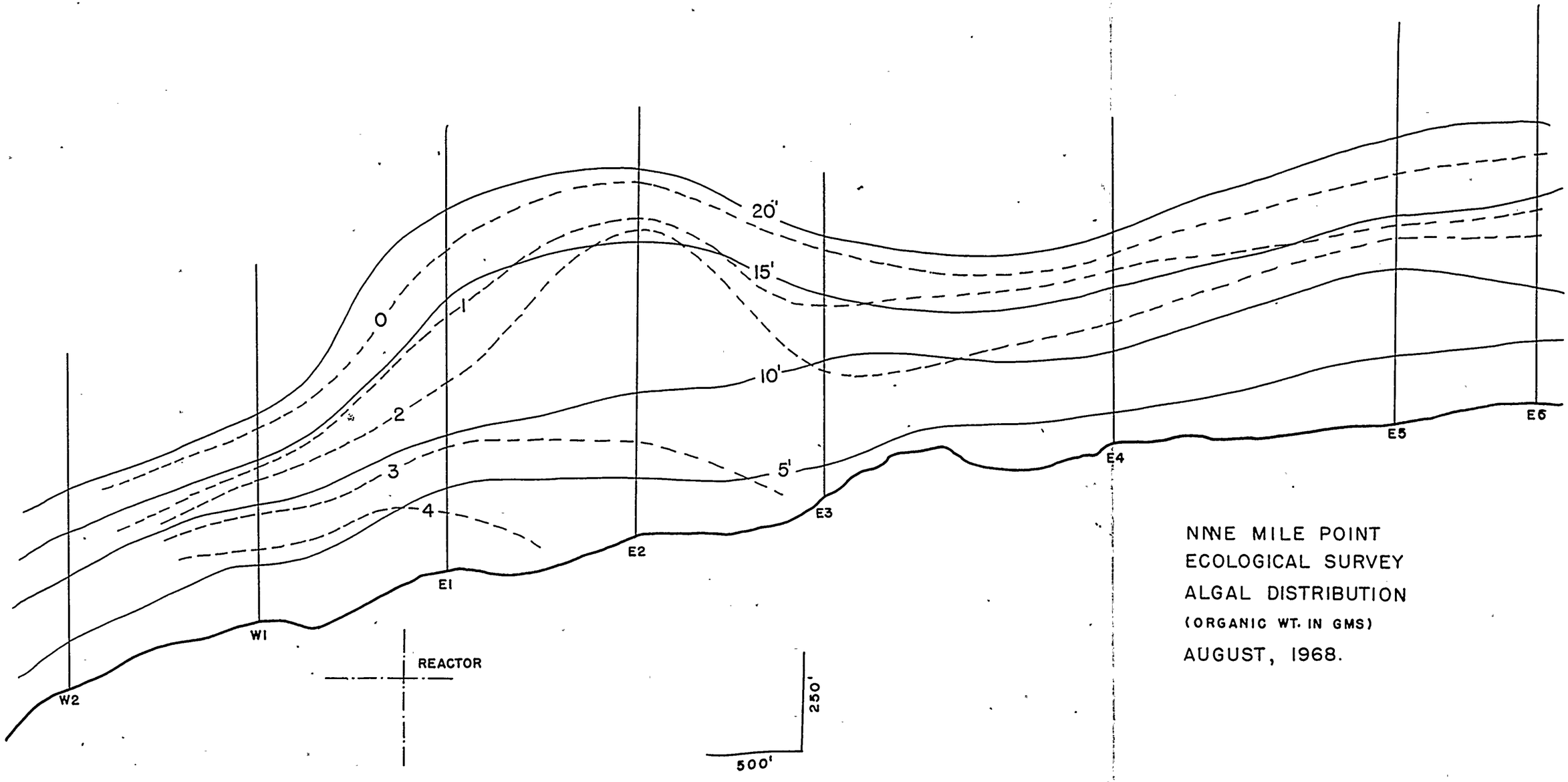
Table 1: Benthic Survey Data - Comparison of Transects (cont.)
Oswego
August, 1968

	transect no.	organic wgt. (gms)	no. of snails (G. Lioplax)	no. of snails (G. Bethnia)	no. of snails (G. Physa)	no. of amphipods (G. Gammarus)	no. of insect larvae (G. Tendipes)	miscellaneous
15'	W3	.30	2	0	0	44	0	-
	W1	.64	0	0	0	35	0	-
	E1	.63	1	0	1	128	4	3 flatworms (G. Dugesia)
	E2	2.25	0	0	0	290	1	-
	E3	1.12	2	0	1	32	8	-
	E6	.96	6	0	1	52	0	-
20'	W3	N.S.T.	-	-	-	-	-	-
	W1	.44	2	0	0	40	0	1 flatworm (G. Dugesia)
	E1	N.S.T.	-	-	-	-	-	-
	E2	N.S.T.	-	-	-	-	-	-
	E3	N.S.T.	-	-	-	-	-	-
	E6	N.S.T.	-	-	-	-	-	-

Table 2: Benthic Survey Data - Algae Dry, Ash, and Organic Weights
Oswego
August 1968

sample depth	transect no.	algae dry wgt. (gms)	algae ash wgt. (gms)	organic wgt. (gms)
5'	W3	*N.S.T.	-	-
	W1	4.51	.30	4.21
	E1	4.71	.80	3.91
	E2	4.24	.42	3.82
	E3	3.17	.23	2.84
	E6	3.40	.54	2.86
10'	W3	.36	.05	.31
	W1	2.80	.29	2.51
	E1	2.74	.25	2.49
	E2	2.93	.25	2.68
	E3	2.50	.69	1.81
	E6	2.81	.41	2.40
15'	W3	.33	.03	.30
	W1	.75	.12	.63
	E1	.86	.23	.63
	E2	2.98	.19	1.79
	E3	1.71	.59	1.12
	E6	.95	.13	.82
20'	W3	N.S.T.	-	-
	W1	.54	.08	.44
	E1	N.S.T.	-	-
	E2	N.S.T.	-	-
	E3	N.S.T.	-	-
	E6	N.S.T.	-	-

*N.S.T. = no sample taken = no alga growth.



NINE MILE POINT
ECOLOGICAL SURVEY
ALGAL DISTRIBUTION
(ORGANIC WT. IN GMS)
AUGUST, 1968.

FIG. 1

Figure 2: Organic weight of algae sample in grams vs. depth along ecological transects
Nine Mile Point, L. Ontario
August 14, 1968

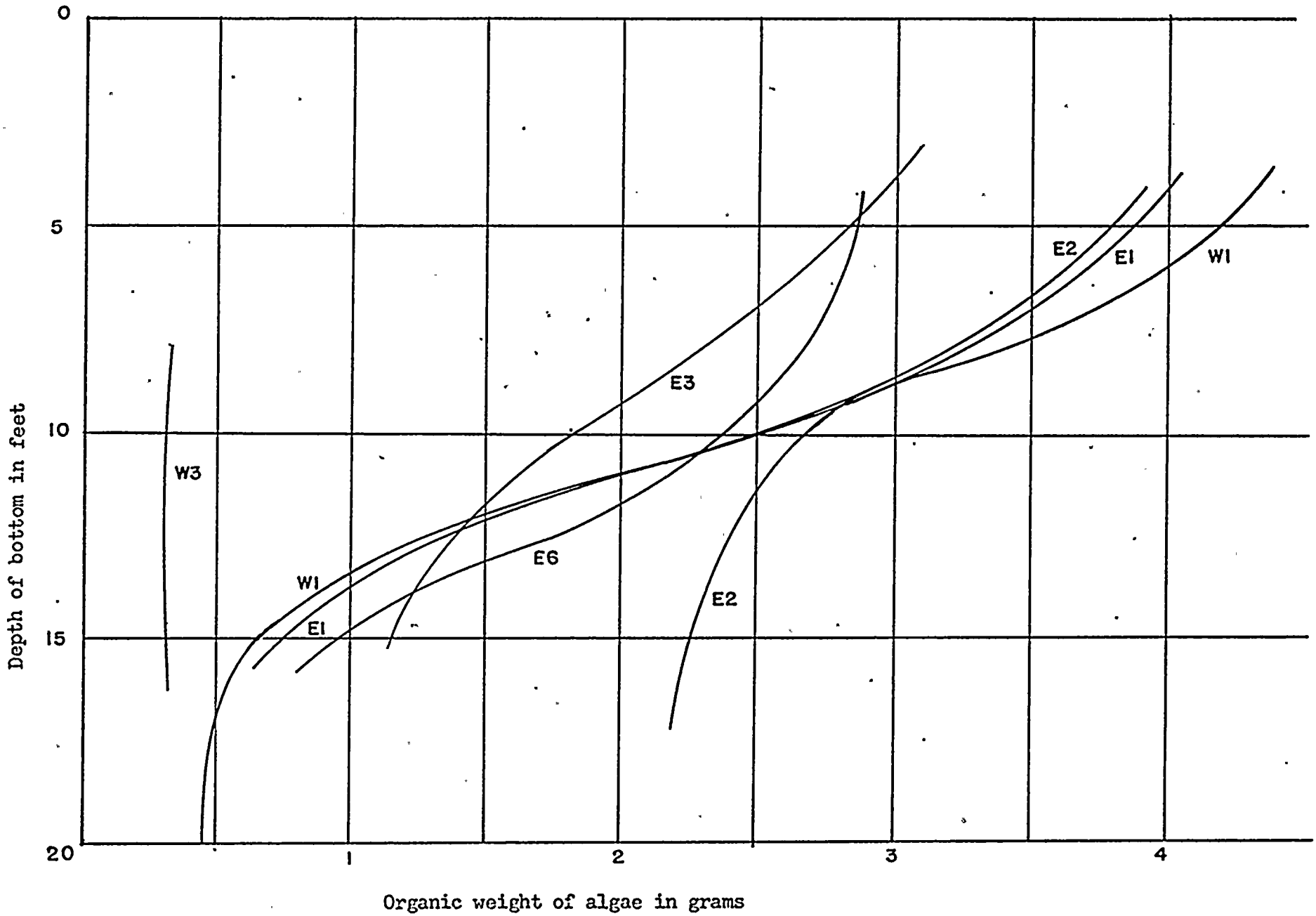


Figure 3: Number of Gammarus (fresh water shrimp) vs. depth along ecological transects
Nine Mile Point, L. Ontario
August 14, 1968

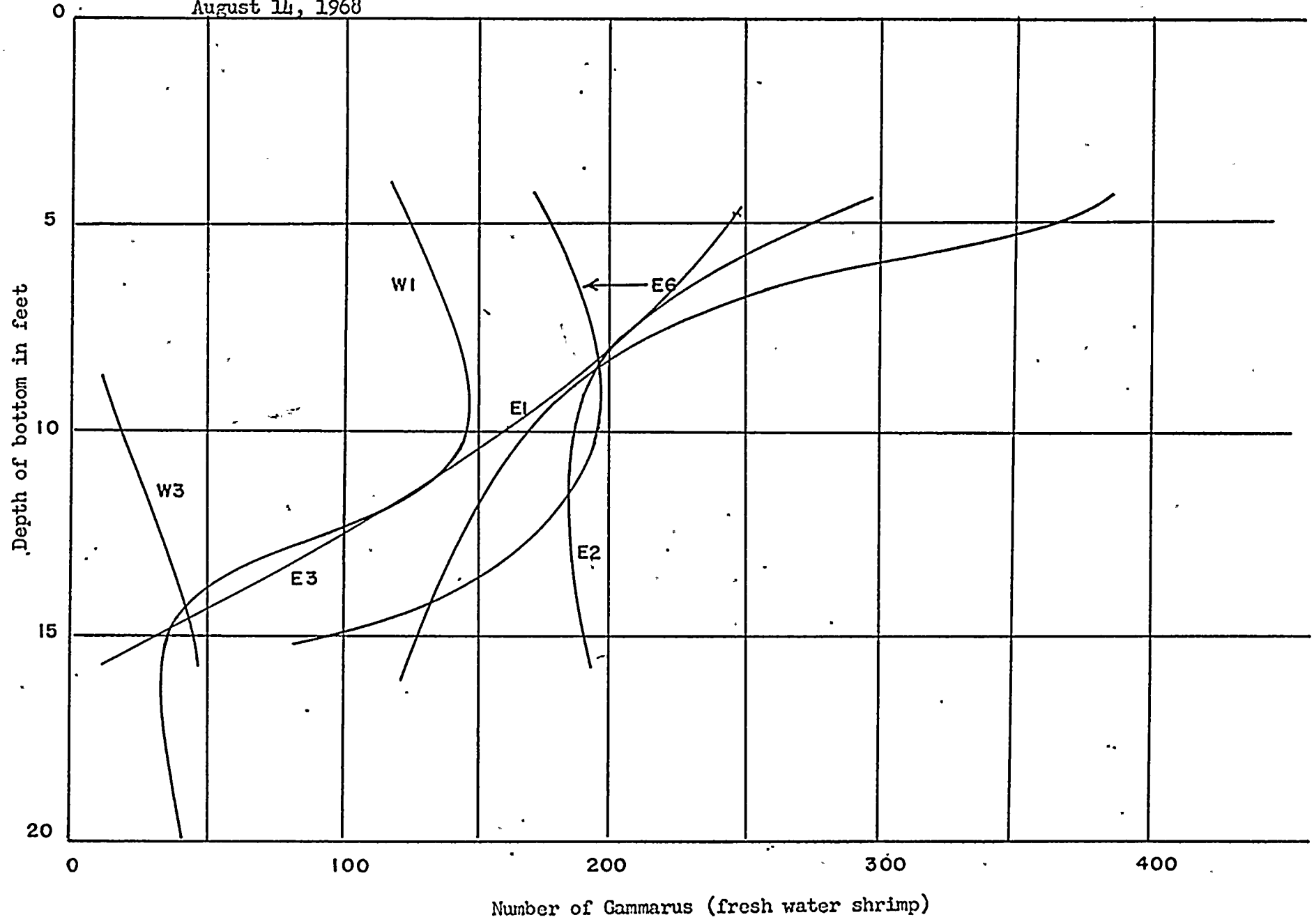
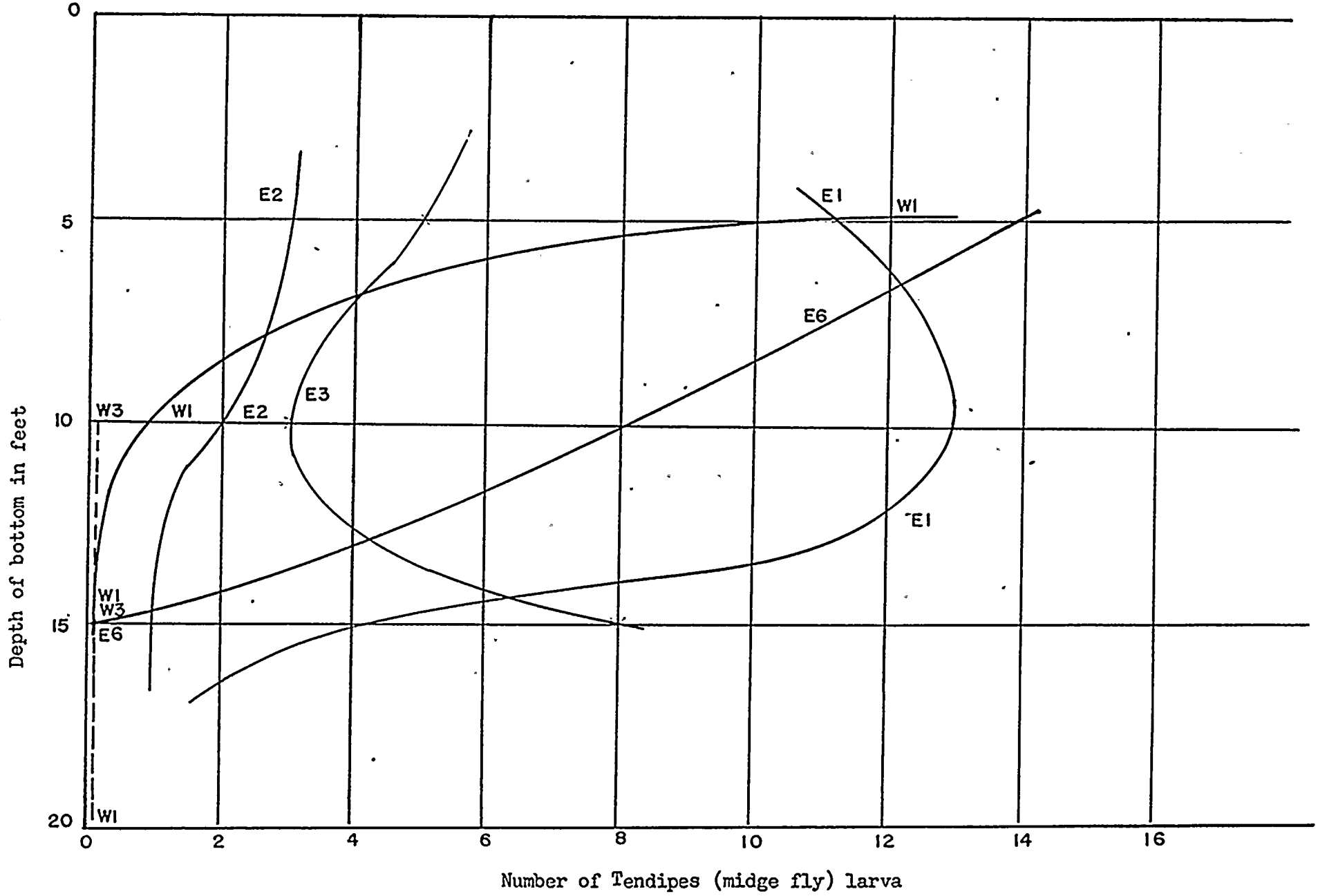


Figure 4: Number of Tendipes (midge fly) vs. depth along ecological transects
Nine Mile Point
L. Ontario
August 14,1968



APPENDIX C

FISH DISTRIBUTION STUDY

NINE MILE POINT, LAKE ONTARIO

JULY, 1968

JOHN F. STORR, Ph.D.
Consultant in Oceanography and Limnology
51 Meadow Lea Drive
Buffalo, New York 14226
Dec. 15, 1969.

Mr. R. Clancy,
Manager, Environment-Engineering,
Niagara Mohawk Power Corp.,
300 Erie Blvd., West,
Syracuse,
New York 13202.

RE: FISH DISTRIBUTION STUDY, NINE MILE POINT, JULY 27, 1968.

A. Purpose of Study.

This was the first study made of the fish distribution in the area using a recording fathometer. Its primary purpose was to try to determine the quantity of fish present in the area by this particular method. As such, the method and the processing of the data is somewhat unique and at this point was experimental. A number of similar surveys has refined the technique and the original fathometric recordings were not processed in detail until recently. It would appear that the methodology is fairly exact and the results very close to actuality. Since, however, we are dealing with fish which are probably in constant motion the results can only give the general pattern of distribution for the day and period during which the fathometrics were done. It must be realized that a second set of fathometrics taken even a few minutes later would give a somewhat different pattern. The fish counts taken from the fathometric tracings and mathematically adjusted, are presented in table 1. The data for total fish count is presented in Figure 1 and because of the method used, gives a fairly accurate picture of this distribution in a graphic form.

B. Method.

1. Field study.

The method used in gathering the basic data was by using a Ross Fine Line Recording Fathometer. This instrument sends out a high frequency pulse at 108 kc through the transducer head which is in a rack in the water over the side of the 16½' boat. The transducer also receives the echo from a 5° arc and this echo is recorded electrographically on a strip chart. Every object from masses of plankton and small fish 3-4 inches in size and the bottom contour is recorded. Relative fish size is also recorded and from experience the below 6" and above 6" size has been separated. Much will depend upon the

expertise of the individual reading the tracings. Some work has yet to be done to refine the interpretation of the tracings, so that some error, particularly in identifying all the smaller fish, does occur. Fish above 6" in length do give a very recognizable trace.

In making these tracings the 0' - 50' depth range is recorded on the strip chart. Tracings were made from a 4' - 5' out to a 50' or more depth along each of the original ecological transects described in detail in the report on the benthic studies. In all, 9 transects were run covering a shore length of about two miles with the central 7 transects only about 1000' apart (Fig. 1).

Boat speed was between 2-3 mph.

2. Laboratory analysis.

Since the transducer was scanning an arc of about 5^{o}, the fish count taken from the tracings had to be treated mathematically to give a uniform result. The objective was to calculate the approximate number per 1000 ft^2 in every 200' distance of the transect. Assuming that the width of the bottom scanned at a 50' depth is 5' wide, it was assumed that all fish counted along a 200' distance in the 40' to 50' depth would equal the total number of fish in 1000 ft^2. Successively above this area all fish counted in a 200' distance were multiplied by factors as follows:

30' - 40' X 1.25
20' - 30' X 1.66
10' - 20' X 2.5
0' - 10' X 5

In the depths closer to the surface the fish counted, are being multiplied by a weighted factor which tends to skew the result. Nevertheless the results to be within an acceptable range and in all of the studies made, give closely comparable results.

C. Discussion.

The results presented in the table and figure are believed to be quite accurate for water depths 15' or more in depth. In the shallower water the area of the scan is probably somewhat limiting. Thus the chance of obtaining a trace of a fish in this shallower water becomes less. Also there is some probability that in very shallow water that fish would tend to move away from the boat as the boat approaches.

On the table the number of fish larger than 6" is also

indicated. This averages out so that about 60% of the fish are recorded are larger than 6". The smaller minnow would probably not be recorded by the fathometer.

In the shallow water, however, no fish could be observed and the water was clear enough to see fish if they were present. A considerable number of dives were made in this area as well, and no fish were observed in shallow water close to shore during the day. Later studies carried out over a 24 hour period showed that as many fish were to be netted in shallow water at night as at the 15' and 30' depths at the bottom. Also the 24 hour fathometric studied indicate that in some areas and in some depths, as many as 10 times the number of fish will be recorded. This is not a general rule but over very favorable bottom where physical conditions such as current, bottom roughness, and bottom profile are of a combination preferred by the fish that such concentrations can occur.

Comparing the results of this particular study to that of other areas, the number of fish present is not great. In fact, the number of fish present in the layer between 60'-80' off of this area is 30 to 40X this concentration at this time of day.

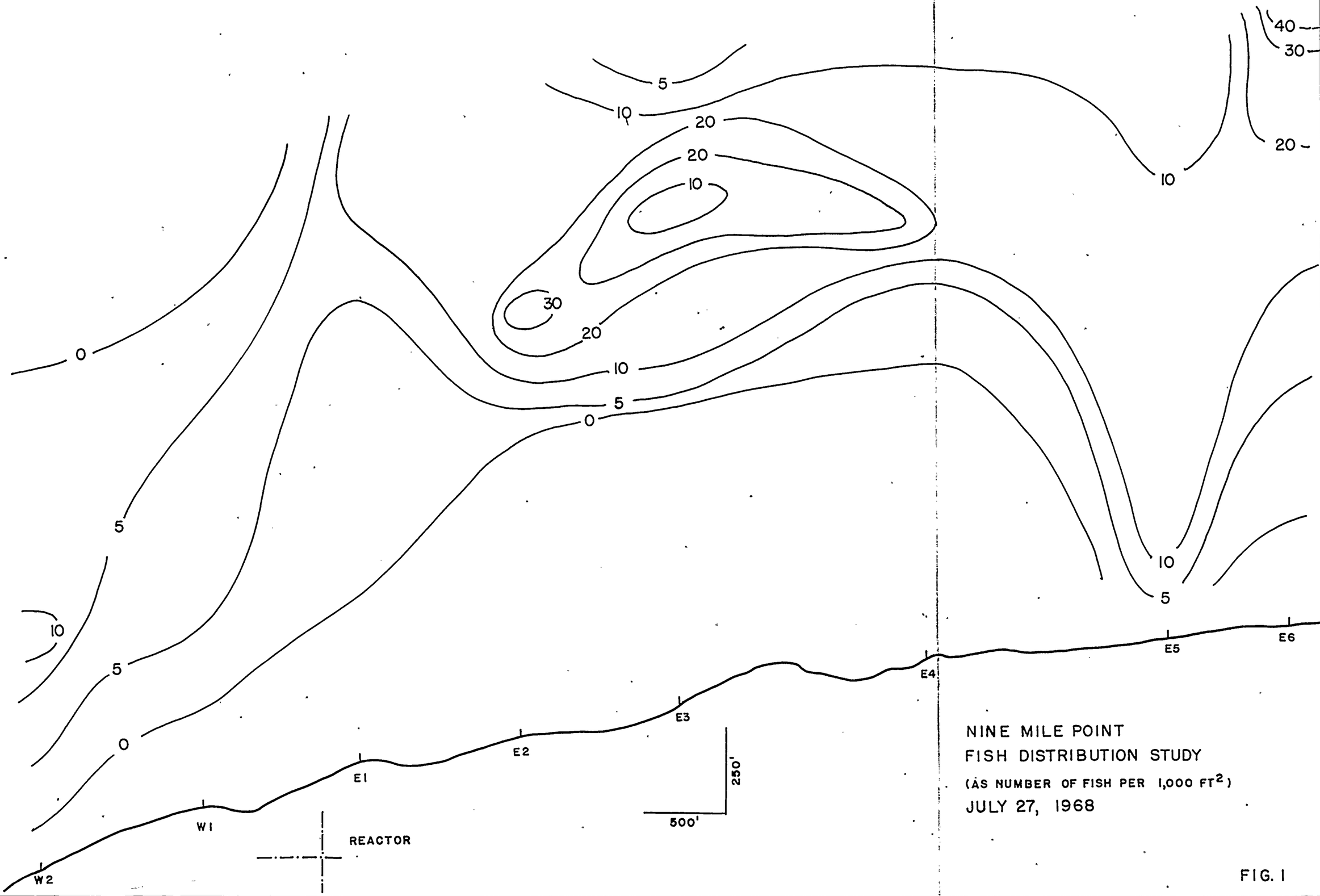
The species of fish present in the area in shallow water has determined later by fish net studies. In greatest abundance are the alewives. Yellow perch out number all the other bottom fish caught in the net by a factor of 2X to 5X. A few white perch were caught and a number of minnows (Notropis sp.) In a week's netting with five 6' X 125' experimental nets, less than an average of 1 of each per day of the red sucker, rock bass, carp, brown bullhead, white bass, and cisco, were taken in water depths from shore to 30'. A few smelt were also caught. One specimen of each of a few other species was also taken.

It would appear from all of the background information available, both from actual work at the site and scientific report that the discharge will not affect the normal movement of any of the fish present. If anything, more fish will be attracted to the area both because of the added heat and modification and change in water movement.

Nine Mile Point Fish Distribution Study
(as number of fish per 1,000 ft^2)
July 27, 1968

Depth	W--3		W--2		W-1		E-1		E-2		E-3		E-4		E-5		E-6	
	T*	L*	T	L	T	L	T	L	T	L	T	L	T	L	T	L	T	L
0-200	7	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0
200-400	2	0	5	5	0	0	0	0	0	0	2	0	0	0	17	7	0	0
400-600	22	10	2	0	5	2	0	0	0	0	5	0	0	0	12	2	5	0
600-800	9	2	10	0	2	2	2	0	0	0	0	0	0	0	7	0	4	0
800-1000	7	2	4	0	9	7	2	2	0	0	25	0	0	0	10	4	7	4
1000-1200	29	8	2	0	7	5	2	2	13	8	20	0	3	0	12	9	17	2
1200-1400	17	2	3	2	2	2	2	2	34	22	7	0	21	9	11	6	7	3
1400-1600	8	1	0	0	0	0	6	2	18	11	24	2	16	1	7	7	23	11
1600-1800	5	1	1	1	-	-	13	6	-	-	5	0	13	4	5	1	21	15
1800-2000	0	0	-	-	-	-	16	10	-	-	7	1	7	4	-	-	40	23
2000-2200	2	2	-	-	-	-	-	-	-	-	3	0	-	-	-	-	68	30
2200-2400	0	0	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-
Total fish	108	28	27	8	25	18	43	24	65	41	99	3	60	18	86	38	192	85
% of fish greater than 6" of total	36%		29%		72%		56%		62%		3%		30%		44%		43%	

* T = total fish counted
* L = only fish over 6" long



NINE MILE POINT
FISH DISTRIBUTION STUDY
(AS NUMBER OF FISH PER 1,000 FT^2)
JULY 27, 1968

FIG. 1